

REMARKS

With the cancellation of claims 14-17 and the addition of new claims 18-21, above, claims 1, 3-11, 13 and 18-21 will be pending in the above-referenced Application (claims 2 and 12 having been canceled without prejudice in Applicant's responses dated July 24, 2002 and December 11, 2002, respectively).

Claims 1, 3, 5-8 and 11 stand rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 4,643,956 to Sandelli, *et al.* ("Sandelli") in view of Japanese Patent Publication JP 59042781, and as unpatentable over Sandelli in view of Japanese Patent Publication JP 08-151461. Claim 10 also stands rejected under 35 U.S.C. § 103(a), as unpatentable over Sandelli and JP 08-151461, in further view of U.S. Patent No. 4,592,968 to Taylor ("Taylor"). Claim 13 stands rejected under 35 U.S.C. § 102(b) as anticipated by Taylor. Claims 4 and 9 stand allowed.

The Applicant has carefully reviewed the March 10, 2003 Final Office Action. The Applicant is requesting entry of the foregoing requested amendments to place the claims in allowable condition. The amendments address the point raised by the Examiner in his helpful comments regarding the maintenance of temperature below the carbonizing temperature during the heat press molding step, rather than the mold charging step. In view of the cancellation of the temperature limitation from the charging step, the Applicant respectfully requests pending new matter objection be withdrawn.

The Applicant also is proposing amendments to the independent claims to reflect the present invention's maintenance of separator temperature below the carbonizing temperature throughout the separator manufacturing process, as described, for example, at specification page 20. Finally, the Applicant is requesting amendment to add new claims 18-21, which are based on canceled claims 14-17, but with the non-carbonizing temperature limitation associated with the heat press mold step.

For the reasons set forth in the following remarks, the Applicant believes that upon entry of the foregoing amendments, claims 1, 3, 5-8, 10-11, 13 and 18-21 would be in allowable form in addition to allowed claims 4 and 9. The Applicant thus respectfully requests reconsideration of the pending rejections and issuance of a Notice of Allowance for claims 1, 3, 5-11, 13 and 18-21.

1. The Amended Claims Are Patentable Over the Cited References.

a. Processing Below the Carbonization Temperature.

In the Applicant's December 11, 2002 Remarks, it was argued that none of the cited references disclose or suggest the present invention's maintenance of temperature below the carbonizing temperature of the resins. The March 10, 2003 Final Office Action, in addition to noting that the temperature limitation more appropriately belongs in the heat press molding step than the mold charging step, maintains that Taylor discloses maintaining temperature below the carbonizing temperature during Taylor's heat press step. March 10, 2003 Final Office Action at 8.

As currently proposed, the independent claims would recite not only that the temperature remains below the carbonizing temperature during the heat press step, but further that the temperature remains below this level throughout the remaining separator manufacturing steps, *i.e.*: "completing manufacture of the separator while maintaining the temperature of the separator equal or less than a temperature at which the epoxy resin and the phenolic resin are carbonized."

This feature is not disclosed or suggested in any of the cited references; indeed, Taylor teaches away from this feature. The example cited by the Examiner in Taylor includes, in the step immediately after the heat press step, the partially-completed separator was placed into a high temperature furnace "and heated to 1850°F (1010°C) *to carbonize the part.*" Taylor at 8:21-24 (emphasis added). The other cited references similarly teach use of high heat to carbonize the separator materials. *See, e.g.*, Sandelli at 7:12-18' ("heating to about 1850°F in a ... carbonization cycle"). Accordingly, the proposed amendments would result in claims that are allowable over the cited references.

b. The Mixture Proportions That Result In Minimum Gas Generation and Minimum Thermosetting Time Were Not Obvious.

The Applicant further traverses the pending rejections under § 103(a) of the claims as unpatentable over Sandelli and JP 59042781 or JP 08-151461 on the grounds that these references, either alone or in combination, do not teach or suggest all the features of the proposed amended claims.

The March 10, 2003 Office Action acknowledges that Sandelli does not teach a process of mixing phenolic resins and epoxy resins to form a separator, maintains that JP

59042781 teaches such a mixture, and finally maintains that it would have been obvious to one of ordinary skill in the art to react the functional groups “in about a 1:1 stoichiometry” as the reaction goes to completion. March 10, 2003 Office Action at 4-5. The Applicants respectfully submit that the Examiner’s assumption of the obviousness of achieving 1:1 stoichiometry is erroneous and reflects hindsight review of the art in light of knowledge of the present invention.

First, as amended, the claims would recite that the present invention remains below the carbonizing temperature during the entire the forming process. There is nothing in Sandelli, JP 59042781 or JP 08-151461 that teaches or suggests that resin component mixture proportions of the present invention (*i.e.*, 0.8-1.2) would achieve the desired features of the present invention *when the Sandelli and JP 59042781 or JP 08-151461 combinations were processed at carbonizing temperatures*. Sandelli at 7:12-18 (“heating to about 1850°F in a ... carbonization cycle”); JP 08-151461 (use of mixtures suitable processing at high (calcining) temperatures -- “1000-3000 degrees C” -- with no discussion of mixtures suitable for low temperature processing). Additionally, given the huge difference in process temperatures between the carbonizing processes taught in the prior art and the present low-temperature process, is there any reason to conclude *a priori* that the desired product would be obtained merely from use of stoichiometric mixtures.

Second, review of the cited references suggests that, contrary to the Examiner’s hindsight assessment, there was not a wide-spread recognition in the art that the low-temperature heat-pressing of the present resin components at a 0.8-1.2 ratio would achieve the desired product in an efficient manufacturing process. The present specification discusses the fact that the Applicants observed that both gas generation *and* production processing time can be minimized using the disclosed mixture range: “Generally, the epoxy resin requires thermosetting time longer than the phenolic resin. By balancing amounts of the epoxy resin and the phenolic resin, *elongation of the manufacturing time can be prevented while suppressing generation of gas*. The amount of epoxy resin may be set to be greater than that of the phenolic resin as far as the manufacturing time is in the allowable range.” Application at 25:11-22; *see also* at 4:11-25 (discussing suppression of gas generation in the present low-temperature process and “preventing elongation of a time required to thermoset the binder owing to excessive increase in the amount of the epoxy resin”).

Finally, contrary to the assertion of obviousness to one of ordinary skill, the prior art does not appear reflect as “common knowledge” the problem solved by Applicant’s mixture range. The Office Action’s assertion of obviousness of “1:1 stoichiometry” inherently assumes that the 0.8-1.2 range was set in order to suppress by-products of the *epoxy-phenolic reaction*. To the contrary, the present specification makes clear that Applicant did not determine that the 0.8-1.2 range was necessary to minimize gas production as a result of incomplete *mutual* epoxy and phenolic resin consumption, but instead to minimize a *different* problem -- the generation of water vapor *where only the phenolic resin* (and its hydroxyl group) *are present as a binder*. The Applicant recognized that the addition of the epoxy resin in the specified range would avoid the undesired generation of *water vapor* by the phenolic resin, and thereby avoid significant swelling and void formation problems during rapid application of heat and pressure. *See, e.g.,* Application at 24:11-24 (“When only phenolic resin is used as the binder, hydroxyl group contained therein reacts to generate water. ... Meanwhile, when using both phenolic resin and epoxy resin as the binder, the hydroxyl group of the phenolic resin reacts with the epoxy group of the epoxy resin, *which generates no vapor.*”). Thus, the Applicant respectfully submits that the Examiner’s reliance on a post-hoc assertion of what would have been obvious to one of ordinary skill is misplaced, as it would not have been obvious -- at the time of the present invention -- to select the 0.8-1.2 range to solve the *water vapor* problems resulting from the use of an excess amount of phenolic resin, and to minimizing production process time, as set forth in the present Application.

For the foregoing reasons, the Applicant respectfully submits that, as amended, the presently pending claims recite an invention that would not have been obvious at the time of invention to one of skill in the art reviewing the cited references. Entry of the proposed amendments and reconsideration and withdrawal of the pending rejections is therefore respectfully requested.

Conclusion

In view of the foregoing requested amendments and remarks, it is respectfully submitted that entry of the proposed amendments would place presently claims 1, 3, 5-8, 10-11, 13 and 18-21 in condition for allowance along with allowed claims 4 and 9. The Applicant therefore earnestly solicits entry of the amendments and issuance of a Notice of Allowance for claims 1, 3-11, 13 and 18-21.

The Examiner is invited to contact the undersigned at (202) 220-4232 to discuss any matter concerning this application.

The Office is authorized to charge any underpayment or credit any overpayment to Kenyon & Kenyon Deposit Account No. 11-0600.

Respectfully submitted,



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MARKED-UP VERSION OF REQUESTED AMENDMENTS

1. (Fifth amendment) A method of manufacturing a separator for a fuel cell comprising:

preparing a raw material by mixing a carbon, an epoxy resin and a phenolic resin, wherein said phenolic resin is different from said epoxy resin, and further wherein a ratio of an amount of an epoxy group of said epoxy resin to an amount of a hydroxyl group of said phenolic resin in the raw material is adjusted to a value ranging from 0.8 to 1.2 such that generation of a reaction byproduct gas is minimized;

charging the raw material into a predetermined mold [at a temperature which is equal or less than a temperature at which the epoxy resin and the phenolic resin are carbonized];
[and]

heat press forming the raw material charged into the mold at a temperature which is equal or less than a temperature at which the epoxy resin and the phenolic resin are carbonized; and

completing manufacture of the separator while maintaining the temperature of the separator equal or less than a temperature at which the epoxy resin and the phenolic resin are carbonized.

10. (Thrice amended) A method of manufacturing a separator for a fuel cell comprising:

preparing a raw material by mixing a carbon, an epoxy resin and a phenolic resin, wherein said phenolic resin is different from said epoxy resin;

charging the raw material into a predetermined mold;

heat press forming the raw material charged into the mold at a temperature which is equal or less than a temperature at which the epoxy resin and the phenolic resin are carbonized; and

completing manufacture of the separator while maintaining the temperature of the separator equal or less than a temperature at which the epoxy resin and the phenolic resin are carbonized, wherein the completion of manufacture includes grinding a surface of the separator which is brought into contact with an adjacent member to be eliminated when the separator is incorporated into a fuel cell.

13. (Twice amended) A method of manufacturing a separator for a fuel cell comprising:

preparing a raw material by mixing a carbon and a resin;

charging the raw material into a predetermined mold;

heat press forming the raw material charged into the mold at a temperature which is equal or less than a temperature at which the [epoxy] resin is [and the phenolic resin are] carbonized; and

completing manufacture of the separator while maintaining the temperature of the separator equal or less than a temperature at which the resin is carbonized, wherein the completion of manufacture includes grinding a surface of the separator which is brought into contact with an adjacent member to be eliminated when the separator is incorporated into a fuel cell.